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Carboxyl-functionalized graphene oxide polyamide nanofiltration membrane for desalination of dye solutions containing monovalent salt

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Abstract:

Novel carboxyl-functionalized graphene oxide (CFGO)/polyamide (PA) nanofiltration (NF) membranes were prepared via interfacial polymerization (IP) of piperazine (PIP) and trimesoyl chloride (TMC). CFGO was fabricated by a chemical modification (ring opening followed by esterification) to the epoxide ring of GO. CFGO was then introduced in the PIP aqueous phase as an additive in the IP reaction. Compared with a pristine PA reference membrane, both the GO/PA and CFGO/PA membrane have an enhanced permeability (the optimum concentration of GO and CFGO in the membrane was 0.05% and 0.07%, and the corresponding water flux is 96.5 and 112.1 L/m^2/h, respectively),with a slight decrease of the salt rejection. In dye desalination experiment, the permeation flux of 0.05%GO/PA membrane is only 75.5 L/m^2/h, with 98.1% rejection of New Coccine (a dye with negative charge) and 28.7% retention for NaCl. For 0.07%CFGO/PA membrane, it can cut off 25.0% NaCl and 95.1% New Coccine, and its permeation flux can reach 110.4 L/m^2/h, which shows that the CFGO/PA membrane could be potentially applied to the dye desalination and concentration process. The CFGO/PA membrane shows better performances in permeability and dye desalination than GO/PA membrane, due to the significantly increased hydrophilicity and enhanced surface charge density.

Keywords: carboxyl-functionalized graphene oxide; polyamide; nanofiltration; hydrophilicity; dye desalination and concentration